SB761
.A3 A5
no. 79-4

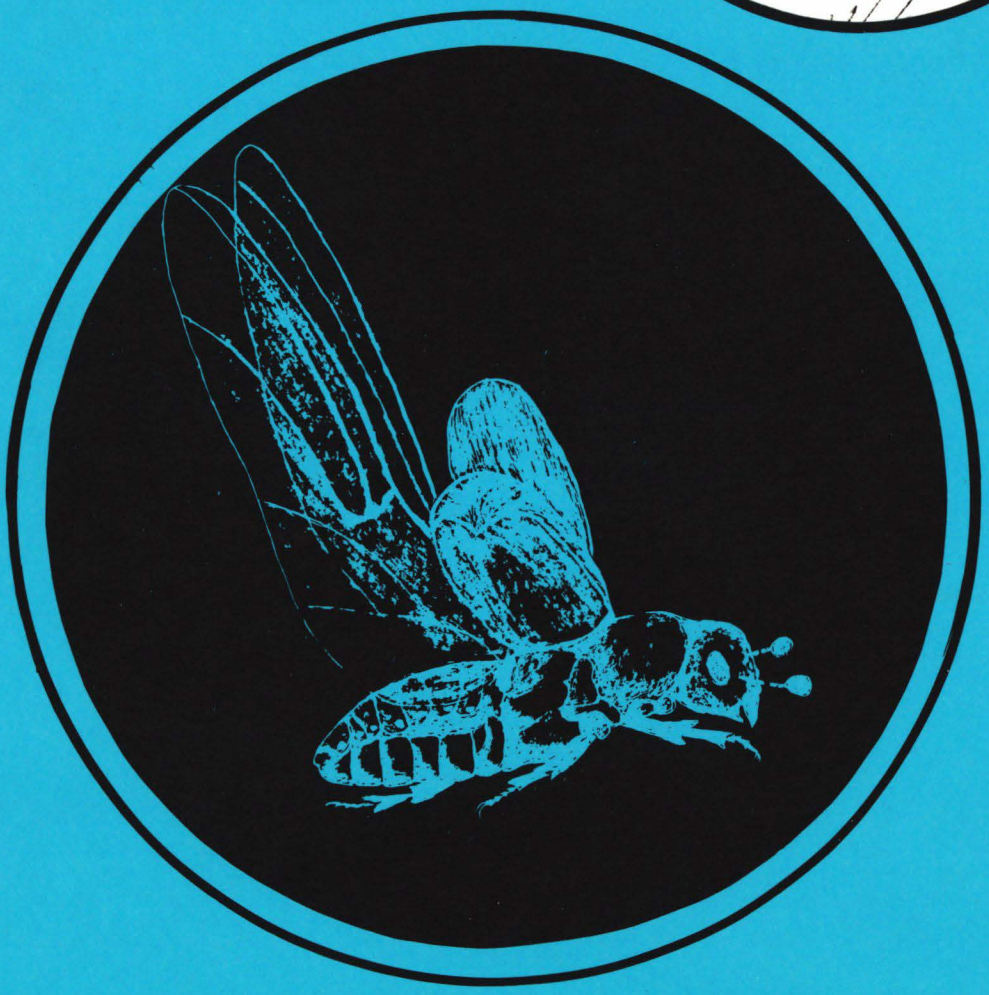
Forest Insect And Disease Management

BIOLOGICAL
EVALUATION R10-79-4

SPRUCE BEETLE

SUMMIT LAKE, DRY GULCH,
COOPER LANDING

CHUGACH NATIONAL FOREST
NOVEMBER 1979



U.S. Department of Agriculture
State and Private Forestry

Forest Service
Alaska Region

BIOLOGICAL
EVALUATION R10-79-4

SPRUCE BEETLE

SUMMIT LAKE, DRY GULCH,
COOPER LANDING

CHUGACH NATIONAL FOREST
NOVEMBER 1979

Prepared by:
Edward H. Holsten, Entomologist
Forest Insect and Disease Management
Region 10, Alaska

Kenneth P. Zogas, Bio-Technician
Forest Insect and Disease Management
Region 10, Alaska

Approved by:
Robert D. Averill, Group Leader
Forest Insect and Disease Management
State and Private Forestry
Region 10, Alaska

Marvin C. Meier, Director
State and Private Forestry
Region 10, Alaska

ROCKY MOUNTAIN RESEARCH STATION LIBRARY
FORT COLLINS CENTER
240 W PROSPECT RD
FORT COLLINS, CO 80526-2098

Forest Insect and Disease Management
State and Private Forestry
USDA Forest Service, R10
2221 E. Northern Lights Blvd., Suite 107
Anchorage, Alaska 99504

INTRODUCTION

Spruce beetle populations (Dendroctonus rufipennis (Kby.)) have dramatically increased throughout Alaska. White spruce (Picea glauca [Moench] Voss.) mortality is occurring on 12,286 hectares[1/] of the Chugach National Forest, an increase of 6,085 hectares (50 percent) over the area infested in 1978. Specifically, mature white spruce stands along the Seward Highway near the Hope Road (Dry Gulch) (254 hectares), Summit Lake (2605 hectares) and across the Kenai River from Cooper Landing (318 hectares) are undergoing spruce beetle buildups, (Fig's. 1,2). All three areas contain three to four year old blowdown in addition to being relatively close to ongoing infestations (Resurrection Creek). These factors probably have served as beetle sources for the three outbreaks.

If these outbreaks are allowed to run their natural cycles, significant changes in stocking levels and aesthetic qualities of the landscape will occur. Accordingly, it was decided that Biological Evaluations should be undertaken in these areas. A Biological Evaluation of the Summit Lake outbreak was undertaken in 1978 (Averill 1978). However, a second condensed evaluation was carried out in 1979 to determine if there were any significant changes in the beetle population.

1/ 1 hectare = 2.471 acres

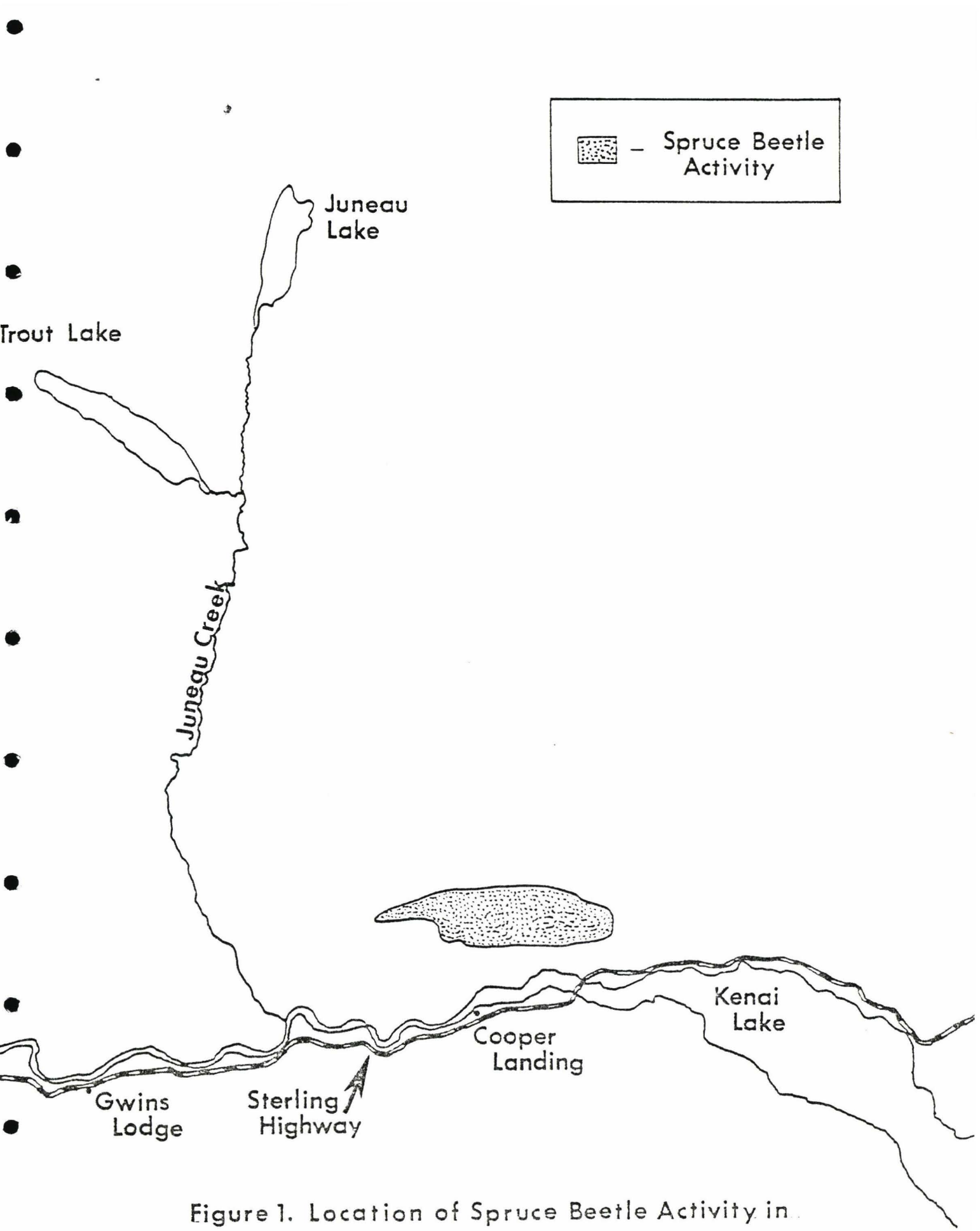


Figure 1. Location of Spruce Beetle Activity in the Cooper Landing Area

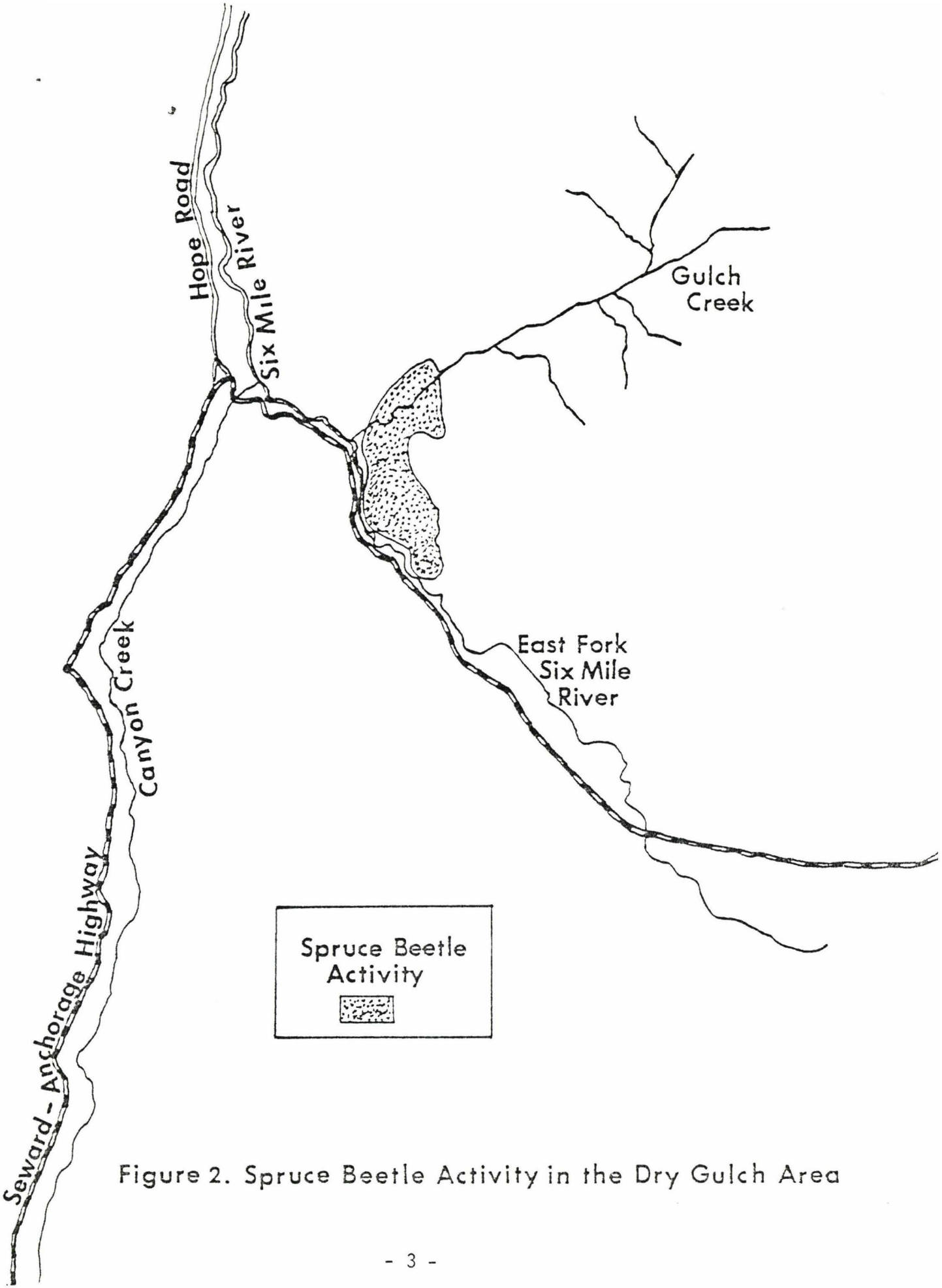


Figure 2. Spruce Beetle Activity in the Dry Gulch Area

The majority of Alaska spruce beetles undergoes a two year life cycle (Werner et al. 1977). However, there appears to be a proportion of the population which completes their life cycle in one year. When the location of abundant breeding material (large diameter logging debris, windfall) coincides with zones of rapid beetle development, the population of mature beetles can greatly increase in one season. This can result in greater populations flying and attacking new hosts the following spring. Accordingly, a preliminary study of the occurrence of the one year life cycle was undertaken within the Summit Lake infestation.

METHODS

1. Stand Composition: Ground surveys were conducted near Cooper Landing, Summit Lake and Dry Gulch during August 1979. Ten and eight variable plots (BAF=10) were established at Cooper Landing and Dry Gulch, respectively. Plots were established at five chain intervals on lines five chains apart distributed throughout the stand. A basal area 10-factor prism and a Spiegal Relaskop were used to determine plot, trees and tree heights. All trees within each plot were recorded by species, d.b.h. and total height. Radial growth was determined for two spruce trees (dominant or co-dominant) in each plot.

2. Spruce Beetle Populations: When spruce beetle infestation centers were encountered, two 6 x 6 inch bark samples (north and south side) were removed from infested trees at d.b.h. Trees selected for sampling were attacked in the Spring of 1977. These trees contained new adults which will form the 1980 attacking population. The number of adults per bark sample was recorded along with the number and type of parasites and amount of woodpecker activity. Results were compared with Knight's (1960) sequential sampling plan for spruce beetle to give an indication of population trends.

3. One Year Life Cycle: Summit Lake is approximately 1,000 feet above sea level. The climate can generally be characterized by short, cool summers and long, cold winters with heavy snowfall; a harsh environment for spruce beetles. Six mature, uninfested white spruce were felled in May, 1979. 6" x 6" bark samples were removed the following September from each side of the felled trees at the base, mid-bole and 6" top. Numbers of larvae, pupae and callow adults were recorded.

RESULTS

Cooper Landing

1. Stand Composition: The Cooper Landing stand can be generally described as one containing pockets of white spruce intermixed with open areas of alder. Birch is sparsely intermixed with the spruce. Pockets of two to four year old blowdown are evident. Figure 3 gives the distribution of tree species by diameter class. Mean d.b.h. for the species are: white spruce 11.3± 3.3" and paper birch (Betula papyrifera Marsh.) 10.3± 1.3". Mean height and age for the spruce are 56± 12.25' and 220± 10.5 years, respectively.

   Mean basal area for plots containing spruce is 83± 13.5 square feet per acre. Basal area within these plots ranges from 20 to 140 square feet. The mean outer inch of spruce radial growth is 32± 7 rings per inch. Thus, spruce diameter growth is averaging .06 inches per year in the last inch of growth. Mean volume for plots containing spruce is 5,069± 3,424 B.F.M.[1/] per acre.

1/ Volume estimates were derived from R-10 Volume Tables for Alaska white spruce in board feet. Forest Service Handbook 2425. January 1967.

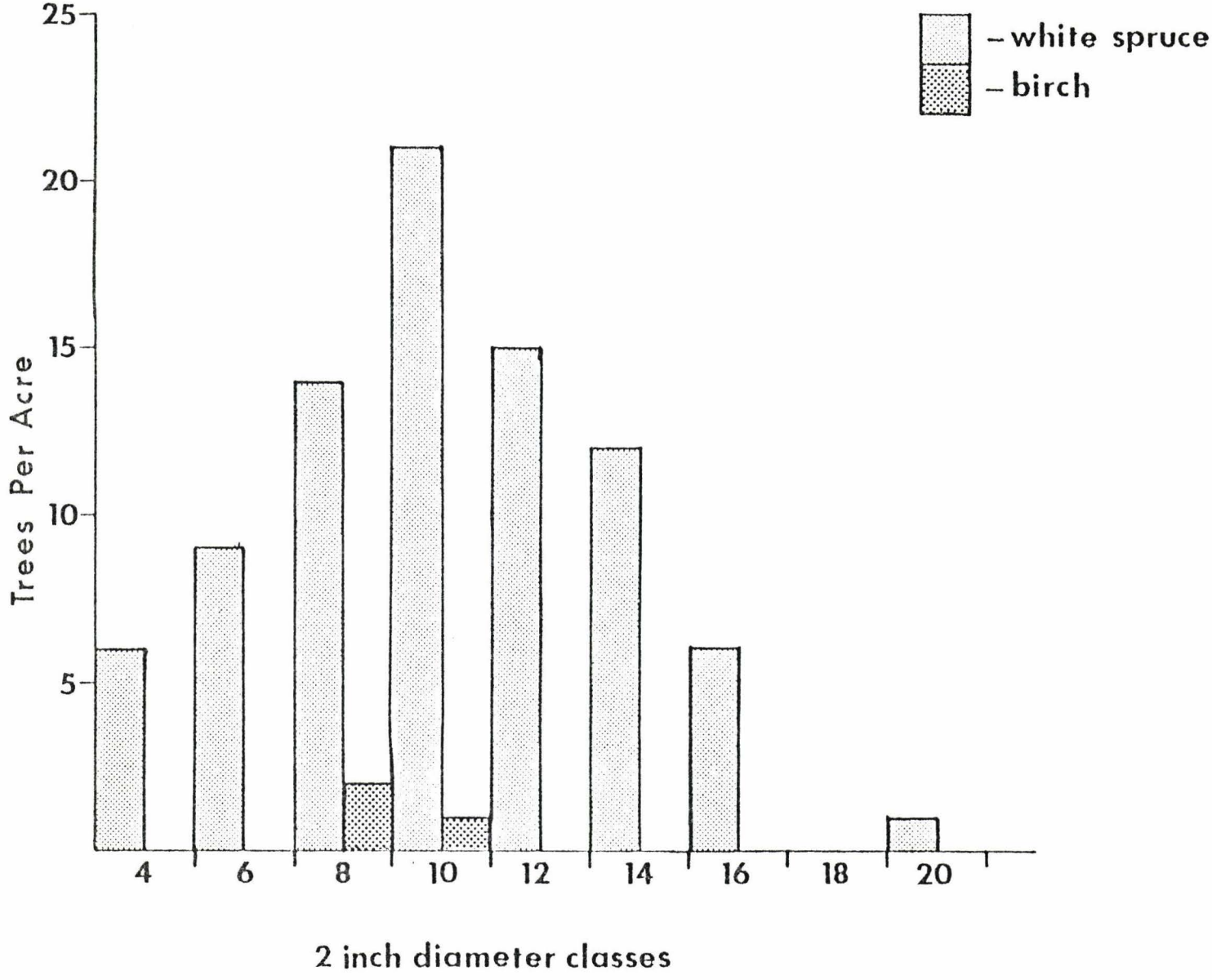


Figure 3. Distribution of Tree Species by Diameter Class within the Cooper Landing Infestation

2. Spruce Beetle Populations and Tree Mortality: Twenty bark samples were removed; all contained adult spruce beetles. A total of 252 spruce beetles were counted; mean adult density per sample was 12.6± 7.8 beetles indicating an increasing population (Knight 1960). Parasitism was less than one percent and woodpecker activity was light in the sample trees.

Mean diameters of recently attacked and old attacked-killed white spruce are 10.55± 2.75" and 13.51± 2.83". Diameters of old attacked-killed spruce are significantly greater (Students "T", P.05) than recently attacked trees.

Average white spruce volume of the infested area is 5.069± 3424 b.f. per acre. Of this volume, 37.9± 33.8 percent is standing beetle killed timber (1926 b.f./acre). An additional 41 percent (2,078 b.f./acre) of the commercial timber is presently attacked and the majority will die. Twenty-one percent of the commercial timber remains free of attack.

Dry Gulch

1. Stand Composition: The steep Dry Gulch stand is composed of spruce interspersed with pockets of paper birch, alder and willow with some Mtn. Hemlock higher up the slopes. Scattered blowdown occurs throughout the area. Figure 4 shows the distribution of tree species by diameter class. Mean d.b.h. for the species are: white spruce 9.8± 4", black spruce (Picea mariana [Mill.] B.S.P.) 5.5+ 0.61"; Mtn. Hemlock (Tsuga mertensiana [Bong] Carr.) 6.8± 1.2" and paper birch 6.9± 1.9". Mean height and age for the white spruce are 44.5± 20' and 136± 56 years, respectively.

   Mean basal area for plots containing white spruce is 55± 8.2 square feet per acre, ranging from 20 to 90 square feet. The mean outer inch of spruce radial growth is 24± 6 rings per inch; spruce diameter growth is averaging .08 inches per year in the last inch of growth. Mean volume for plots containing white spruce is 2544± 1968 b.f. per acre.

2. Spruce Beetle Populations and Tree Mortality: Twenty bark samples (90% infested) were removed and yielded a total of 167 adult spruce beetles; mean adult density per sample was 8.35± 8 beetles. These numbers indicate an increasing spruce beetle population (Knight 1960). Twenty percent of the samples had dipteran bark beetle predators (Medetera spp.:Dolichopodidae); heavy woodpeckering was apparent on all sample trees.

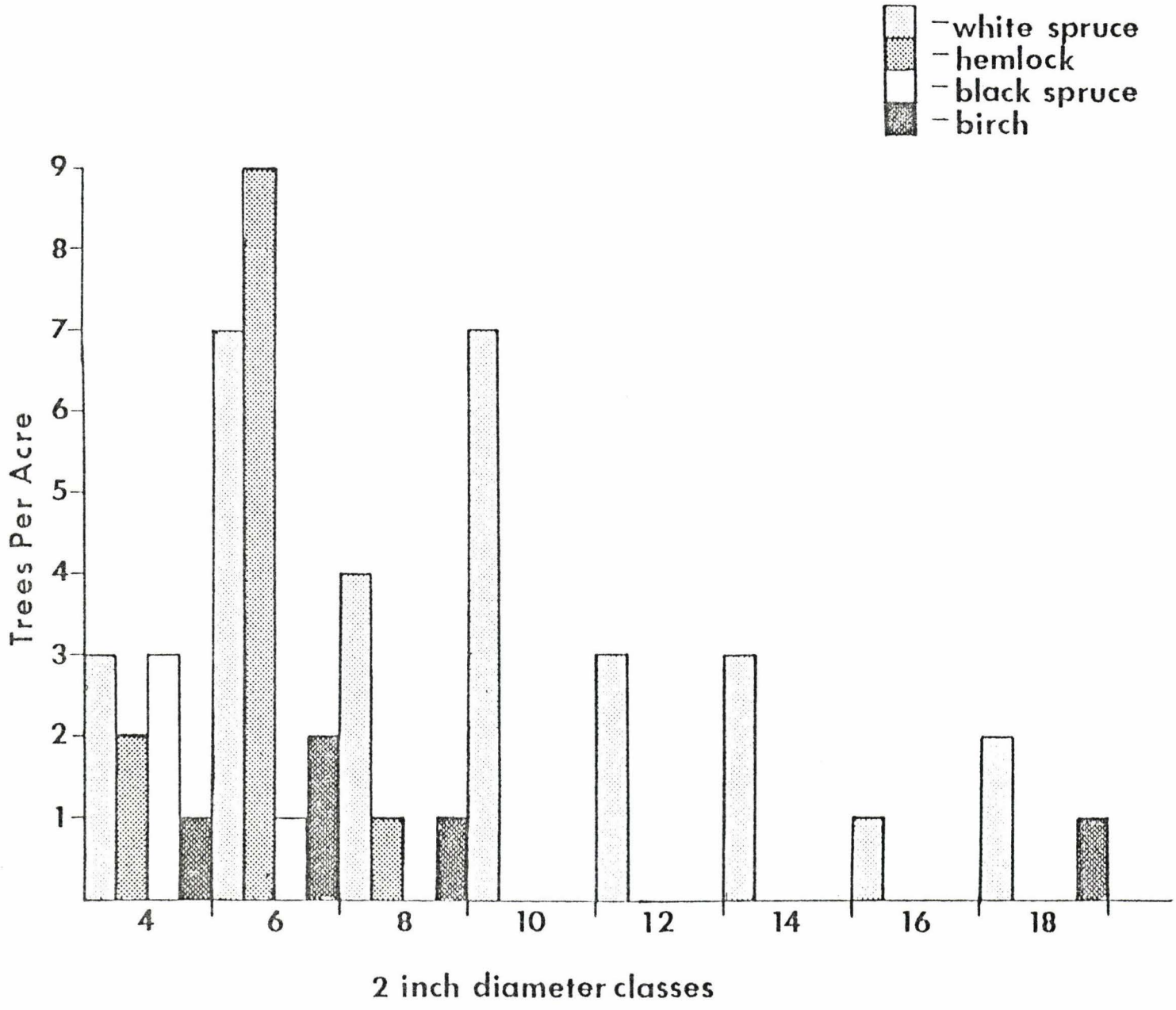


Figure 4. Distribution of Tree Species by Diameter Class within the Dry Gulch Infestation

Mean diameter of recently attacked and old attacked-killed white spruce are 14.3± 3" and 16± 0.64", respectively. Sample size of old attacked-killed spruce was too small to determine whether the above diameters were significantly different. Of the white spruce volume, 9.6± 21.5 percent (254 b.f./acre) is in standing beetle killed timber. An additional 42 percent (1068 b.f./acre) of the commercial white spruce volume is under attack; the majority will be killed. Forty-eight percent of the commercial spruce volume is free of beetles.

Summit Lake

1. Stand Composition: (See Averill 1978).

2. Spruce Beetle Populations and Tree Mortality: Twenty bark samples were removed. Ninety-five percent contained spruce beetles. A total of 174 spruce beetles were counted; mean adult density per sample was 8.7± 7.5 beetles, indicating an increasing population (Knight 1960). The 1979 beetle densities are higher (not significant) from the 7.42± 7.9 densities reported by Averill (1978).

3. One Year Life Cycle: A total of 280 larvae, pupae and callow adults were recorded. Larvae accounted for 78 percent (two year life cycle); the remaining 22 percent were pupae and callow adults (one year life cycle).

DISCUSSION

Cooper Landing

The Cooper Landing outbreak is not new. In 1978, light beetle activity was noted in this area. Due to the past two dry, warm springs, beetle flight and spring attacks have been very successful, resulting in increased beetle activity in 1979.

The probable cause for this outbreak is the substantial amount of scattered, large diameter spruce blowdown. This material is favored by the spruce beetle for brood material. Also a few miles to the northwest of Cooper Landing is the Resurrection Creek outbreak which probably has served as beetle population sources.

Beetle populations are still increasing but it is doubtful whether this outbreak will continue for more than two years. Seventy-nine percent of the commercial white spruce has been killed or is presently being attacked. Supportive of this limited trend in beetle activity is the fact that significantly smaller trees are presently being attacked with respect to those already killed. The mean d.b.h. of the 1979 attacked spruce is less than the average d.b.h. of the whole spruce component. This downward trend indicates a future decline in spruce beetle activity as brood production and development decreases when the diameter of attacked trees approaches 8 inches.

An excellent discussion of management implications and control alternatives is found in Averill (1978) and is applicable to the Cooper Landing outbreak. However, due to the advance nature of the Cooper Landing outbreak, silvicultural manipulations (e.g. thinning of residual stand and removal of present beetle brood) is not warranted. Salvage logging, on the other hand, is a viable option.

The currently infested material should be removed to another area where the brood should be destroyed. This should be undertaken in fall, winter or early spring before the beetles emerge. Another viable alternative is the felling and burning of the infested trees. This could be done with minimum risk to other values and should be undertaken in the winter months.

Dry Gulch

The increased beetle activity and related kill near Dry Gulch should come as NO surprise. Portions of the infested stand (CA7-15) were designated as a medium-high risk stand (Holsten and Wolfe 1979); a stand which under certain conditions, would experience significant beetle kill. Obviously such "certain conditions" were realized. The two consecutive dry, warm springs and the occurrence of scattered large diameter blowdown probably served as beetle population sources for this outbreak.

Approximtely 50 percent of the commercial spruce has been killed or is presently being attacked. At this stage, only the large diameter spruce (14" or more) are being attacked. It appears that this outbreak is young and will continue to destroy spruce for at least three years if no suppression measures are undertaken. A "no control" or "do nothing" approach would probably result in a potential stand composition favoring hardwoods. The limited access into this after may favor a program of felling and burning of infested trees. There are an additional five righ risk stands nearby. If the Dry Gulch beetle populations are not suppressed, they will probably serve as an invading beetle source and future outbreaks would be spread along the Sterling Highway from Summit Lake to Granite Creek Guard Station.

Summit Lake

Results of the 1979 ground survey indicated that Summit Lake beetle populations are still increasing. The 1979 FI&DM aerial surveys indicated that this outbreak has substantially increased and intensified and is now scattered over approximately 2605 hectares. This increased activity is centered around the Devil's Pass Trailhead (med-high risk stand, Holsten and Wolfe 1979) and is spreading towards the Sterling-Seward Highway cut-off. A demonstration of silvicultural manipulations as proposed by Averill (1978) should be completed in this area during Fall-Winter (1979-1980). Should this demonstration prove successful in reducing beetle attack within the area, additional

treatments should be considered after beetle flight in 1980. Such a technique will not only reduce the insect threat but will serve to enhance a multiple of management objectives in these high valued roadside areas.

1. One Year Life Cycle: The results of the preliminary life cycle study demonstrated that 22 percent of the Summit Lake spruce beetle population can complete development in one year. In a similar study undertaken in British Columbia (Dyer 1969), up to 96 percent of beetle progeny completed their development in one year. Considering the Summit Lake weather, there are undoubtedly other areas in the Chugach National Forest with zones of more rapid beetle development. It is reasonable to believe that the ability of spruce beetles to change to a one year life cycle in response to favorable weather conditions undoubtedly increases the potential for invasion and death of standing timber as well as maintaining outbreak levels. Future spruce beetle investigations will concentrate on the one year life cycle and its effect on spruce beetle population dynamics.

Impacts

Assuming a $20/MBF stumpage value[1/] for white spruce on the Kenai Peninsula, the monetary loss resulting from present spruce beetle infestations can be derived for the following areas:

1. Cooper Landing: Value of commercial white spruce within the 318 hectare outbreak is approximately $79,400. Of this amount, $30,650 of spruce has been killed by the spruce beetle and $33,000 worth of timber is presently being attacked. As of fall 1979, $16,500 of white spruce is free of attack. However, some of this timber will eventually be killed.

2. Dry Gulch: The 254 hectare Dry Gulch infestation has a much smaller component of white spruce than the Cooper Landing stand (2540 BF/acre vs. 5070 BF/acre). The monetary value of Dry Gulch beetle kill is approximately $3,140. The value of timber presently under attack, of which the majority will die, is $13,190. If no suppression measures are undertaken, an additional $15,000 of white spruce could possible be killed.

1/ Fred Harnisch. October 1979. Personal Communication, Anchorage, Ak.

The effects of bark beetles on the landscape have a variety of impacts (Averill et al. 1977). The ratio of green spruce to "red topped" spruce to gray snags will increase toward the snag end of the scale if spruce beetle populations continue increasing. With respect to the Cooper Landing outbreak, the introduction of "red tops" and snags into the landscape will be more subdued as the outbreak is a good distance away from major roads or development. The Dry Gulch outbreak, on the other hand, is quite visible from the highway. The introduction of color or variety in this case may be unacceptable due to the psychological impact of introducing dying plant materials (Averill et al. 1977).

Scenic quality and usage appear to be of high value and top priority on the Chugach National Forest. Unfortunately, there is no satisfactory system for evaluating their economic worth. However, any project benefit/cost analysis of spruce beetle suppression must present as much of a data base as possible with respect to the scenic quality of the affected landscape.

REFERENCES

Averill, R.D., Gunter, J.F., Lister, C.K. and D.H. Sonnen. 1977. Guidelines for Estimating the Economic Benefits of Mountain Pine Beetle Control Projects. Technical Report R2-11, Forest Service and Disease Management. U.S.D.A Forest Service, Rocky Mtn. Region. 30p.

___ 1978. Spruce Beetle-Summit Lake. Biological Evaluation R-10-78-3. For. Ins. and Dis. Mgt. State and Private Forestry. U.S.D.A. Forest Service, Alaska Region. 8p.

Dyer, E.D.A. 1969. Influence of Temperature Inversion on Development of Spruce Beetle, Dendroctonus obesus (Mann.) (Coleoptera: Scolytidae) J. Entomol. Soc. British Columbia. 66:41-45.

Holsten, E.H. and R.L. Wolfe. 1979. Spruce Beetle Risk Rating System for White Spruce on the Kenai Peninsula. Tech. Rpt. R10-1. For. Ins. and Dis. Mgt. State and Private Forestry. U.S.D.A. Forest Service, Alaska Region. 21p.

Knight, F.B. 1960. Sequential sampling of Englemann spruce beetle infestations in standing trees. U.S. Dept. of Agric., For. Serv. Rocky Mtn. For. and Range Exp. Sta. Res. Note 47, 4p.

Werner, R.A., Baker, B.H. and P.A. Rush. 1977. The Spruce Beetle in White Spruce Forests of Alaska. U.S.D.A. Forest Service, P.N.W. For. and Range Experiment Station. Gen. Tech. Report. PNW-61. 13p.